To what extent are recently developed technological materials that are designed to improve food safety effective in reducing exposure to pathogens and decreasing the risk of foodborne illnesses in the home?

Conclusion

A limited body of inconsistent evidence describes and evaluates contributions to or advances of food safety modalities or practices in the home. These small studies indicate the correct usage of these kinds of products is critical for assessing proper cooking temperature and ensuring adequate reduction of microbial burden on food contact surfaces. Not all thermometers tested, wipes assessed and sanitizers evaluated were accurate or effective in providing correct cooking temperatures or assuring consistent safety against typical foodborne organisms.

Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, click here.

Evidence Summary Overview

A total of eight studies were reviewed regarding the extent to which recently developed technological materials that are designed to improve food safety are effective in reducing exposure to pathogens and decreasing the risk of food-borne illnesses in the home. Three received positive quality ratings (three randomized block trials) and five received neutral quality ratings (two randomized block trials, two non-randomized trials and one case-control study).

Thermometers

Four randomized block design studies evaluated the accuracy and reliability of several types of cooking thermometers available to the general consumer (LeBlanc et al, 2005; Liu et al, 2009a; Liu et al, 2009b; McCurdy et al, 2004). In two randomized, block designed studies by Liu et al (2009 a and b), the accuracy and reliability of commercially available instant-read consumer thermometers (forks, remotes, digital probes and disposable color change indicators) were assessed in several grades of beef patties and cuts of chicken. Three models of each thermometer were evaluated under three different cooking methods. These studies indicated that all models of thermometers tested were poor indicators of accurate temperatures in that they did not match the calibrated controls over a broad range of acceptance standards. The results suggest that using these thermometers could either undercook or overcook these foods, thereby compromising food safety and food quality, and that these thermometers required more than the recommended time to register products as cooked (Liu, 2009 a and b). LeBlanc et al, (2005) assessed the attributes of six models of analog fork thermometers and six types of digital instant read-probe thermometers. These products were evaluated while cooking pre-formed beef patties and roasts. When applied to these foods, fork thermometers and digital read thermometers underestimated the temperature of the cooked foods by 1°C to 11°C (1.8 to 19.8°F). However, when the thermometers were correctly used according to manufacturers' instructions, such as proper placement in the food for a specified time (at least 30 seconds), the analog and digital thermometers provided reliable information on cook temperatures. In a similar study McCurdy et al, (2004) evaluated 21 models of instant-read pocket food thermometers (eight dial models and 13 digital models available from local grocery, department, and hardware stores, by catalog or Internet order or free from the Idaho Beef Commission). Accuracy and response time were assessed using standardized protocols. Importantly, the accuracy of dial and digital thermometers was good (within 2°F) for 98% of those tested. On the other hand, response time in small meat items was quite variable (10 to 31 seconds).

Antibacterial Products for Cleaning Food Contact Surfaces

A single non-randomized study (DeVere and Purchase, 2007) investigated the effectiveness of domestic antibacterial wipes and sprays in decontaminating food contact surfaces. Four commercially available antibacterial products were evaluated under controlled laboratory conditions. Using *E. coli* and *S. aureus* as Gram negative and Gram positive indicators of food contact surface contaminants, the antibacterial wipes were applied and used as stipulated by the manufacturers. Food contact surfaces included plastic, glass, wood and antimicrobial-treated materials. Microbial survival was the indicator of antimicrobial effectiveness. This small study indicated that the effectiveness of these products was dependent upon the type of surface (e.g., lower microbial reduction with plastic surfaces) and type of antimicrobial product (wipes were least effective compared to sprays). In this study, the effectiveness of the wipes was dependent upon the applier who controlled the amount of surface and degree of pressure applied.

Antibacterial Cutting Boards

A single case-control study (Kounosu and Kaneko, 2007) evaluated the antibacterial properties of cutting boards treated with antimicrobial materials. This small (N=10 households) study, using *E. coli* and *S. aureus* as Gram negative and Gram positive indicators of antimicrobial effectiveness, also monitored other environmental microbes common in kitchens and food preparation areas. The effectiveness of cutting boards in reducing the microbial burden depended upon the antibacterial rating of the cutting boards. Another indicator for home food safety indicated that the use of these antimicrobial cutting boards tended to reduce the concentration of common organisms, such as Pseudomonas, Flavobacterium, Micrococcus and Bacillus, better than untreated cutting boards. The property of antimicrobial cutting boards is based on the natural characteristics of silver-ions to fight off an array of bacteria, fungi, mold and some viruses commonly found in the home kitchen (Kounosu and Kaneko, 2007).

Consumable Sanitizers for Foods

One small randomized block designed study (McKee, 2005) and one non-randomized trial (Yucel Sengun, 2005) evaluated the effectiveness of consumable sanitizers intended to decontaminate foods. McKee et al (2005) evaluated household juices, baking soda, sodium chloride (table salt solution), wine, soy sauce (low pH, high sodium) and vinegar (lower pH) on several cuts of raw chicken. The microbial load of cranberry juice and vinegar-rinsed chicken cuts was typically lower than the other solutions except for 10% sodium chloride and 10% sodium bicarbonate solutions. However, all of the tested in-home products that lowered the pH, particularly white vinegar and salt solution (10% brine), produced a lower microbial burden. In a laboratory study, Yucel Sengun and Karapinar (2005) noted that a solution of equal volumes of vinegar (source of acetic acid) and lemon juice (source of citric acid) can be effective in reducing potential Salmonella burden on lettuce surfaces following a 15-minute no-rinse period.

Evidence Summary Paragraphs

Consumer Thermometers for Use in Testing Temperature of Cooked Food

LeBlanc et al, 2005 (positive quality), a randomized block trial conducted in Canada, evaluated six models of fork thermometers and indicators and six models of digital instant-read probe-style thermometers to determine their accuracy in measuring the cooking temperature of meat. Six units per model were purchased and evaluated in a water-bath; the eight most accurate devices were then tested in pre-formed beef patties (16 batches of nine) and roasts (60 measurements). For beef patties, models of fork thermometers underestimated the temperature by 3°C on average, while digital probe thermometers underestimated the temperature by 2°C; for beef roasts, models of fork thermometers underestimated the temperature of the roasts by 4°C on average, while the digital probe thermometers underestimated the temperature by 1°C. While statistical analysis was not described, both fork and probe-style thermometers were accurate in estimating the cooking temperature of meat, as long as they were properly used, based on following these instructions: Insert from the side in thin cuts of meat so that at least three to four cm of the probe are in the meat, measure temperature within one minute of removal from the heat and leave the thermometer in the meat for at least 30 seconds before reading the temperature.

Liu et al, 2009a (positive quality), a randomized complete block trial conducted in the US, determined the accuracy and reliability of consumer bimetal and digital thermometers used to determine end-point temperature of ground beef patties and chicken breasts. Three models of bimetal thermometers (10 per model) and three models of digital thermometers (10 per model) were purchased and evaluated in a water-bath; thermometers were then tested on four meat products (80% and 90% lean ground beef patties, boneless and bone-in split chicken breasts) and three different cooking methods (gas grill, electric griddle and consumer oven). At the recommended insertion times, the percent of measurements matching the calibrated thermocouple were 14% to 69% for bimetal and 0% to 64% for digital thermometers, and with longer insertion times, bimetal thermometers registered 25% to 81% of the products as cooked while digital thermometers registered 14% to 92% of the products as cooked; results indicate that these thermometers required more than the recommended time to register products as cooked. No study limitations were noted.

Liu et al, 2009b (positive quality), a randomized complete block trial conducted in the US, determined the accuracy and reliability of various consumer food thermometers used to determine end-point temperature of ground beef patties and chicken breasts. Thermometer models evaluated included three fork, three remote, one digital probe and two disposable color change indicators. Thermometers were purchased and evaluated in a water-bath; thermometers were then tested on four meat products (80% and 90% lean ground beef patties, boneless and bone-in split chicken breasts) and three different cooking methods (gas grill, electric griddle and consumer oven). At the recommended insertion time, all models registered less than 42% of the products as cooked, except for one indicator model that registered greater than 50% of the products as cooked. Average thermometer readings deviated from the calibrated thermocouple by as much as 64°F. Increasing insertion time increased percentage of product registering as cooked; however, results indicate that consumers using these thermometers would overcook meat to higher temperatures than necessary to destroy harmful microorganisms. No study limitations were noted.

McCurdy et al, 2004 (neutral quality), a randomized block trial, with a cross-sectional survey component, determined the accuracy and response time of a sampling of instant-read thermometers and determined the availability of instant-read food thermometers to consumers in rural and urban areas of Idaho and Washington states. Thermometers evaluated included 21 models of instant-read pocket food thermometers (eight dial models and 13 digital models) and three units of each model were obtained if possible. The accuracy (at 160°F) and the response time of the dial and digital instant-read thermometers were measured by use of a temperature-controlled water bath. Both dial and digital instant-read thermometers were accurate within 2°F when tested in a 160°F calibrated water bath (all but one of the 57 thermometers were acceptably accurate when used for the first time after removal from packaging). Response time to reach 160°F from ambient temperature for dial thermometers was 16 to 25 seconds (average 21 seconds) and for digital thermometers it was 10 to 31 seconds (average 18 seconds), with the response time of replicate thermometers being reasonably consistent. Both types required an average of about 20 seconds to register the temperature at 160°F, although some took as little as 10 seconds and others as much as 30 seconds.

Antibacterial Products for Cleaning Food Contact Surfaces

DeVere and Purchase, 2007 (neutral quality), a non-randomized trial conducted in the United Kingdom, investigated the effectiveness of domestic antibacterial wipes and sprays in decontaminating food contact surfaces. Four commercially available antibacterial products (Flash Wipes, Sainsbury's Antibacterial All Purpose Wipes, Dettol Antibacterial Surface Cleanser Spray and Sainsbury Perform and Protect Antibacterial Cleaner Spray) were tested under laboratory conditions on four food contact surfaces: Wood, glass, plastic and Microban® incorporated plastic*Escherichia coli* and *Staphylococcus aureus* were used to investigate the effectiveness of the antibacterial products on both Gram-positive and Gram-negative bacteria. In the absence of any antibacterial products, both bacteria survived up to 120 minutes on all test surfaces. Bacterial survival on wood and Microban® incorporated plastic surfaces were low after each drying time, whereas high levels of bacteria were detected on plastic and glass surfaces. All of the antibacterial products were effective at decontaminating the test surfaces with the exception of Flash Wipes. In addition, only plastic appeared to affect the effectiveness of the antibacterial products, where the reduction in bacterial number was significantly lower than the other test surfaces ($P<0.05$). A small number of samples were included in the study, and authors note that the amount of product applied by a wipe was reliant on the applier who controlled the area of the surface to which the product was applied and the level of pressure used.

Antibacterial Cutting Boards

Kounosu and Kaneko, 2007 (neutral quality), a case-control study conducted in Japan, examined antibacterial cutting boards with antibacterial activity values of either "2" or "4" in compliance with the Japanese Standards Association 2000 (JIS Z 2801) and compared their findings with those of cutting boards with no antibacterial activity. Ten households used each kind of board on successive days. Every day, the households washed the cutting boards after use with a scrubbing brush and running water and let them dry naturally; before using the cutting board the next day, an area was swabbed with Q-tips, which were collected and examined for bacteria at weeks one, two, four and six. Cutting boards with activity values of "2" and "4" were antibacterial in actual use, although no correlation between the viable cell counts and antibacterial activity values were observed; the activity values of the "2" boards were 2.24 against*Staphylococcus aureus* and 2.10 against *Escherichia coli*, while activity values of the "4" boards were 3.88 against *Staphylococcus aureus* and 3.68 against *Escherichia coli*. In the kitchen environment, large quantities of Pseudomonas, Flavobacterium, Micrococcus and Bacillus were detected and the concentrations of these bacteria tended to be greater on untreated cutting boards used for the same periods. Statistical analysis was not described; authors note that the differences between the households can be attributed to the different ingredients used, frequency of cooking and other related factors.

Household Consumable Sanitizers for Decontaminating Food

McKee et al, 2005 (neutral quality), a randomized block trial conducted in the US, determined the effect of readily available, consumable decontamination fluids such as juices and vinegar on total aerobic, total coliform and generic *Escherichia coli* counts on retail raw, skinless, boneless chicken breasts. In the first study, 100 chicken breast samples underwent a one-minute rinsing treatment in distilled white vinegar, refrigerated orange juice, apple juice, cranberry juice cocktail, 2% low-fat milk, clam juice, 10% sodium chloride solution, 10% sodium bicarbonate solution, baking soda and tap water, while in the second study, 50 chicken breast samples were rinsed with chicken broth, soy sauce, red wine, white wine and Italian dressing. No differences were found in initial total aerobic or total coliform counts in either study. In the first study, the total aerobic count for chicken breasts rinsed with distilled white vinegar (3.22 log CFU per cm^2) was lower than for those rinsed with all other solutions except cranberry juice cocktail (3.86 log CFU per cm^2), and the total coliform count for chicken breasts rinsed with distilled white vinegar (0.00 log CFU per cm^2) and cranberry juice cocktail (0.20 log CFU per cm^2) were lower than those for all other solutions except 10% sodium chloride solution (0.43 log CFU per cm^2) and 10% sodium bicarbonate solution (0.48 log CFU per cm^2). In the second study, the total aerobic count for chicken breasts rinsed with red wine (5.29 log CFU per cm^2) and white wine (5.32 log CFU per cm^2) were lower than those for the other three solutions and the total coliform count after rinsing chicken breasts with chicken broth (4.48 log CFU per cm^2) was higher than for all other solutions than Italian dressing. Although distilled white vinegar was the most effective rinsing agent, all solutions produced lower microbial counts after rinsing. However, the two studies were conducted at different times with different rinsing solutions and therefore might not be comparable in effectiveness.

Yucel Sengun and Karapinar, 2005 (neutral quality), a non-randomized trial conducted in Turkey, determined the sanitizing effect of lemon juice, vinegar and their mixture on*Salmonella typhimurium* on salad vegetables such as rocket and spring onion. Fresh whole rocket leaves and shredded spring onion samples were inoculated with Salmonella typhimurium to provide initial populations of six and three log CFU per gram, and after inoculation, vegetables were treated with either lemon juice, vinegar or a lemon juice-vinegar (1:1) mixture for zero, 15, 30 and 60 minutes. Three replicate trials were completed for each duplicate experiment. Despite the small number of samples, treatment of rocket with fresh lemon juice caused a significant reduction ranging between 1.23 and 4.17 log CFU per gram and treatment of rocket with vinegar caused a significant reduction ranging between 1.32 and 3.12 log CFU per gram, while the maximum reduction was reached by using the lemon juice-vinegar mixture for 15 minutes, which reduced the number of pathogens to an undetectable level. Treatment of spring onion with fresh lemon juice caused a reduction ranging between 0.87 and 2.93 log CFU per gram and treatment of spring onion with vinegar caused a reduction ranging between 0.66 and 2.92 log CFU per gram, while the maximum reduction was reached by using the lemon juice-vinegar mixture for 60 minutes (0.86 to 3.24 log CFU per gram, $P<0.05$).

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Author, Year, Study Design, Class, Rating	Population/Sample Description or Type of Materials	Study Design / I & D Variables / Intervention	Results and Outcomes / Significance	Limitations
Devere and Purchase, 2007 Study Design: Non-randomized Trial Class: C Rating:	Four commercially available antibacterial products (Flash Wipes, Sainsbury's Antibacterial All Purpose Wipes, Dettol Antibacterial Surface Cleanser Spray, and Sainsbury Perform and Protect Antibacterial Cleaner Spray) were tested under laboratory conditions on four food contact surfaces: • Wood • Glass • Plastic • Microban® incorporated plastic. *Escherichia coli* and *Staphylococcus aureus* were used to investigate the effectiveness of the antibacterial products on both Gram-positive and Gram-negative bacteria. Location: United Kingdom.	Investigated the effectiveness of domestic antibacterial wipes and sprays in decontaminating food contact surfaces.	In the absence of any antibacterial products, both bacteria survived up to 120 minutes on all test surfaces. Bacterial survival on wood and Microban® incorporated plastic surfaces were low after each drying time, whereas increased levels of bacteria were detected on plastic and glass surfaces. All of the antibacterial products were effective at decontaminating the test surfaces with the exception of Flash Wipes. In addition, only plastic appeared to affect the effectiveness of the antibacterial products, where the reduction in bacterial number was significantly ↓ than the other test surfaces ($P<0.05$).	A small number of samples was included in the study and authors note that the amount of product applied by a wipe was reliant on the applier who controlled the area of the surface to which the product was applied, and the level of pressure used.
Kounosu and Kaneko, 2007 Study Design: Case-Control Study Class: C Rating:	Antibacterial cutting boards with antibacterial activity values of either "2" or "4" in compliance with the Japanese Standards Association 2000 (JIS Z 2801) and cutting boards with no antibacterial activity. N=10 households used each kind of board on successive days. Location: Japan.	Compared antibacterial cutting boards and cutting boards without antibacterial activity. Every day, the households washed the cutting boards after use with a scrubbing brush and running water and let them dry naturally Before using the cutting board the next day, an area was swabbed with Q-tips, which were collected and examined for bacteria at weeks one, two, four and six.	Cutting boards with activity values of "2" and "4" were antibacterial in actual use, although no correlation between the viable cell counts and antibacterial activity values were observed Activity values of the "2" boards were 2.24 against *Staphylococcus aureus* and 2.10 against *Escherichia coli*, while activity values of the "4" boards were 3.88 against *Staphylococcus*	Statistical analysis not described Authors note that differences between the households can be attributed to the different ingredients used, frequency of cooking and other related factors.

			aureus and 3.68 against *Escherichia coli*. In the kitchen environment, large quantities of Pseudomonas, Flavobacterium, Micrococcus and Bacillus were detected and the concentrations of these bacteria tended to be greater on untreated cutting boards used for the same periods.	
LeBlanc DI, Goguen B et al, 2005 Study Design: Randomized block trial. Class: A Rating:	Six units of six models of fork thermometers or indicators and six units of six models of digital instant-read probe-style thermometers were purchased and evaluated in a water-bath. The eight most accurate devices were then tested in pre-formed beef patties (16 batches of nine) and roasts (60 measurements). Location: Canada.	Evaluated fork thermometers/indicators and digital instant-read probe-style thermometers to determine their accuracy in measuring the cooking temperature of meat.	For beef patties, models of fork thermometers underestimated the temperature by 3°C on average, while digital probe thermometers underestimated the temperature by 2°C. For beef roasts, models of fork thermometers underestimated the temperature of the roasts by 4°C on average, while the digital probe thermometers underestimated the temperature by 1°C. Both fork and probe-style thermometers were accurate in estimating the cooking temperature of meat, as long as they were properly used, based on the following instructions: • Insert from the side in thin cuts of meat so that at least three to four cm of the probe are in the meat • Measure temperature	Statistical analysis was not described.

			within one minute of removal from the heat • Leave the thermometer in the meat for at least 30 seconds before reading the temperature.	
Liu M, Vinyard B et al, 2009 Study Design: Randomized Complete Block Trial Class: A Rating:	Thermometer models evaluated included: • Tthree fork • Three remote • One digital probe • Two disposable color change indicators. Thermometers were purchased and evaluated in a water-bath. Thermometers were then tested on: Four meat products: • 80% and 90% lean ground beef patties • Boneless and bone-in split chicken breasts. Three different cooking methods: • Gas grill • Electric griddle • Consumer oven). Location: United States.	Determined the accuracy and reliability of various consumer food thermometers used to determine end point temperature of ground beef patties and chicken breasts.	At the recommended insertion time, all models registered <42% of the products as cooked, except for one indicator model which registered >50% of the products as cooked. Average thermometer readings deviated from the calibrated thermocouple by as much as 64°F. Increasing insertion time ↑ percentage of product registering as cooked; however, results indicate that consumers using these thermometers would overcook meat to higher temperatures than necessary to destroy harmful microorganisms.	No study limitations were noted.
McCurdy SM, Mayes E et al, 2004 Study Design: Randomized block trial, and cross-sectional survey component. Class: A Rating:	21 models of instant-read pocket food thermometers (eight dial models and 13 digital models) were obtained (three units of each model if possible).	**Design:** Accuracy (at 160°F) and response time of the dial and digital instant-read thermometers (total of 57 food thermometers) was measured by use of a temperature-controlled water bath. Prior to testing each thermometer, accuracy of water bath temperature was verified by checking a factory calibrated glass, certified thermometer. **Dependent variables:**	Both dial and digital instant-read thermometers were accurate within 2°F when tested in a 160°F calibrated water bath (all but one of the 57 thermometers were acceptably accurate when used for the first time after removal from packaging). Response time to reach 160°F from ambient temperature for dial thermometers was 16 to 25 seconds (average 21 seconds) and for	Funding source of study is unclear.

		Accuracy of instant-read pocket thermometers and response time to reach final temperature of instant-read pocket thermometers.	digital thermometers it was 10 to 31 seconds (average 18 seconds), with the response time of replicate thermometers being reasonably consistent. Both types required an average of ~20 seconds to register the temperature at 160°F, although some took as little as 10 seconds and others as much as 30 seconds.	
McKee LH, Neish L et al, 2005 Study Design: Randomized block trial. Class: A Rating:	**First study:** 100 chicken breast samples underwent a one-minute rinsing treatment in distilled white vinegar, refrigerated orange juice, apple juice, cranberry juice cocktail, 2% low-fat milk, clam juice, 10% sodium chloride solution, 10% sodium bicarbonate solution, baking soda and tap water. **Second study:** 50 chicken breast samples were rinsed with chicken broth, soy sauce, red wine, white wine and Italian dressing. Location: United States.	Determined the effect of readily available, consumable decontamination fluids such as juices and vinegar on total aerobic, total coliform and generic *Escherichia coli* counts on retail raw, skinless, boneless chicken breasts.	No differences were found in initial total aerobic or total coliform counts in either study. **First study:** Total aerobic count for chicken breasts rinsed with distilled white vinegar (3.22 log CFU per cm^2) was lower than for those rinsed with all other solutions except cranberry juice cocktail (3.86 log CFU per cm^2) and the total coliform count for chicken breasts rinsed with distilled white vinegar (0.00 log CFU per cm^2) and cranberry juice cocktail (0.20 log CFU per cm^2) were lower than those for all other solutions except 10% NaCl solution (0.43 log CFU per cm^2) and 10% sodium bicarbonate solution (0.48 log CFU per cm^2). **Second study:** Total aerobic count for chicken breasts rinsed with red wine (5.29 log CFU per cm^2) and white wine (5.32 log CFU per cm^2) were	The two studies were conducted at different times with different rinsing solutions and therefore might not be comparable in effectiveness.

			lower than those for the other three solutions and the total coliform count after rinsing chicken breasts with chicken broth (4.48 log CFU per cm^2) was higher than for all other solutions than Italian dressing. Although distilled white vinegar was the most effective rinsing agent, all solutions produced lower microbial counts after rinsing.	
Yucel S and Karapinar M, 2005 Study Design: Non-randomized Trial Class: C Rating:	Fresh whole rocket leaves and shredded spring onion samples were inoculated with *Salmonella typhimurium* to provide initial populations of six and three log CFU per g. After inoculation, vegetables were treated with either lemon juice, vinegar or a lemon juice-vinegar (1:1) mixture for zero, 15, 30 and 60 minutes. Three replicate trials were completed for each duplicate experiment. Location: Turkey.	Determined the sanitizing effect of lemon juice, vinegar and their mixture on *Salmonella typhimurium* on salad vegetables such as rocket and spring onion.	Treatment of rocket with fresh lemon juice caused a significant ↓ ranging between 1.23 and 4.17 log CFU per g and treatment of rocket with vinegar caused a significant ↓ ranging between 1.32 and 3.12 log CFU per g, while the maximum ↓ was reached by using the lemon juice-vinegar mixture for 15 minutes, which ↓ the number of pathogens to an undetectable level. Treatment of spring onion with fresh lemon juice caused a ↓ ranging between 0.87 and 2.93 log CFU per g and treatment of spring onion with vinegar caused a ↓ ranging between 0.66 and 2.92 log CFU per g, while the maximum ↓ was reached by using the lemon juice-vinegar mixture for 60 minutes (0.86 to 3.24 log CFU per g, $P<0.05$).	Small number of samples.

Research Design and Implementation Rating Summary

For a summary of the Research Design and Implementation Rating results, click here.

Worksheets

DeVere E, Purchase D. Effectiveness of domestic antibacterial products in decontaminating food contact surfaces. *Food Microbiol.* 2007 Jun; 24 (4): 425-430. Epub 2006 Sep 27.

Kounosu M, Kaneko S. Antibacterial activity of antibacterial cutting boards in household kitchens. *Biocontrol Sci.* 2007 Dec; 12 (4): 123-130.

LeBlanc DI, Goguen B, Dallaire R, Taylor M, Ryan D, Klassen M. Evaluation of thermometers for measuring the cooking temperature of meat. *Food Protection Trends.* 2005; 25(6): 442-449.

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McCurdy SM, Mayes E, Hillers V, Kang DH, Edelfsen M. Availability, accuracy and response time of instant-read food thermometers for consumer use. *Food Prot. Trends.* 2004; 24(12): 961-968.

McKee LH, Neish L, Pottenger A, Flores N, Weinbrenner K, Remmenga M. Evaluation of consumable household products for decontaminating retail skinless, boneless chicken breasts. *J Food Prot.* 2005 Mar; 68(3): 534-537.

Yucel Sengun I, Karapinar M. Effectiveness of household natural sanitizers in the elimination of Salmonella typhimurium on rocket (Eruca sativa Miller) and spring onion (Allium cepa L.). *Int J Food Microbiol.* 2005 Feb 15; 98 (3): 319-323.